Minnesota for herbarium and library facilities; to Dr. F. J. Hermann, Bureau of Plant Industry for checking distribution data; to Prof. M. L. Fernald for the needed data on the specific status and records of distribution.—Olga Lakela, State Teachers College, Duluth.

TERATOLOGIC TYPHA

Harold St. John

The occasional finding of an abnormal specimen of some well-known plant is an incident of decided interest to the collecting botanist. From that time on, he watches with keener eyes for a repetition of similar monstrosities within that particular species, and soon he can add it to his list of those species which commonly produce teratologic individuals. All of us have such a list of a score or more names, often it is only a mental list, but it is nevertheless available for quick and ready reference. A record of some of these observations may prove of great value to those active in tracing the phylogeny of the species.

During the latter part of August and early September, 1917, Miss Grace M. Bryant noticed and collected some Cat-tails that were decidedly out of the ordinary. Nearly all of these are shown in the accompanying photograph. On September 14th Miss Bryant and the author visited the locality together. It is along both banks of Alewife Brook between Massachusetts Avenue and the first bridge, a railroad bridge, a quarter of a mile distant to the south. The stream here forms the boundary between Cambridge and Arlington. Both Cat-tails, *Typha latifolia* L. and *T. angustifolia* L., occur here along the banks of the sluggish stream, but the latter predominates often forming a continuous fringe.

Three abnormal plants of *T. latifolia* were observed. One is shown to the far right in the photograph. The staminate part of the spike has fallen. Below the broken tip of the stem is the normal pistillate part, while five inches below this and partially sheathed in the axils of the two uppermost leaves is an additional pistillate part. Such specimens with two superposed pistillate parts of the inflorescence have been found before in North America as is indicated by a specimen in the Gray Herbarium and one in the Herbarium of Yale University. The

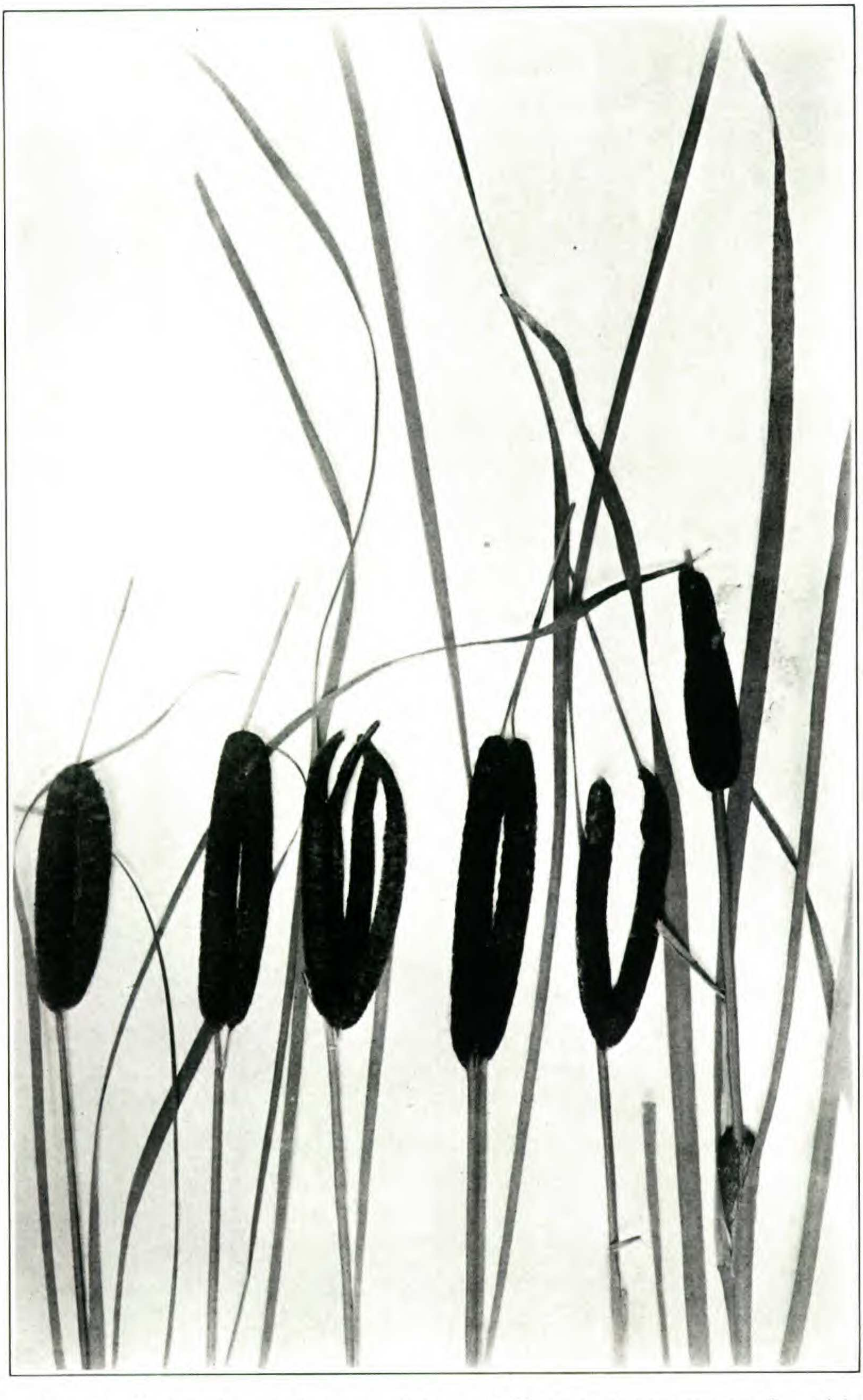

FIG. 1. From the left, five plants of TYPHA ANGUSTIFOLIA L. with juxtaposed pistillate spikes; at the right one TYPHA LATIFOLIA L. with superposed pistillate spikes.

former is without any statement of locality; it was collected by William Boott, July 25, 1869. The latter was found at New Haven, Connecticut, in 1858 by Prof. D. C. Eaton. Dr. G. F. Koch described[1] a somewhat similar condition in a plant with three superposed segments of the spike, the lowest being pistillate, the uppermost being staminate, while the median contained both staminate and pistillate flowers. Similar plants of *T. latifolia* were described and illustrated[2] by Dr. R. v. Soo. The other two abnormal specimens of *T. latifolia* observed along Alewife Brook also had two instead of one pistillate part of the spike, but on these plants the two pistillate parts were juxtaposed or twinned instead of being superposed. On their nearer faces each has a line which seems to represent a line of sterile tissue below and originally the line of cohesion of the two now separate parts. A single stem bears these two but as the fruits and their attendant bristles develop they exert a pressure upon each other causing the splitting of the stem both above and below. The upper part usually gives way utterly, thus reducing the tension on the lower part. In the Herbarium of the New England Botanical Club is just such a specimen as these, MASSACHUSETTS: bog on Day Farm, Scituate, Aug. 13, 1899, *Emile F. Williams*. Also, Mr. R. A. Ware writes me that he found a specimen of just this type in Provincetown, Massachusetts. American authors have occasionally recorded this sort of monstrosity, "The[3] same collector [name not given] has from Carlstadt, N. J., *Typha latifolia*, in which there are several small spikes arising side by side from the top of the culm, and which appear to be due to fission." In the same volume is another record,[4] "Mr. Bicknell displayed . . . specimens of *Typha latifolia*, L., showing fission of the spike." Half a dozen years later it was again recorded,[5] "David F. Day stated . . . that double fertile spikes are not uncommon in *T. latifolia*." This condition has likewise been recorded by European observers, as V. Borbás,[6] L. Ducamp,[7] and J.-B. Gèze.[8]

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[1] Pollichia ix. 23 (1851).

[2] Typha És Hottonia Teratológiak. Archivum Balatonicum ii. 80–83, 2 figs. (1928).

[3] Bull. Torrey Bot. Club vii. 67–68 (1880).

[4] l. c. 93.

[5] Bull. Torrey Bot. Club xiii. 209 (1886).

[6] Orsz. középt. tanáreygesulet Közlönye xiv. 286 (1881); and Oester. Bot. Zeitschr. xxxvi. 81 (1886).

[7] Ass. Fr. Av. Sc., Sess. Ajaccio ii. 533 (1901).

[8] Gèze, J.-B.: Études botaniques et agronomiques sur les Typha etc., U. de Paris, Thèses Série A, no. 680, 41 (1912).

As *T. angustifolia* is more abundant in the locality one would expect to find more than three, perhaps five abnormal plants in the area. On the contrary anyone walking along this stretch of meadowland by either bank of Alewife Brook, could not help being impressed with the abundance of freakish plants of *T. angustifolia*. Without any attempt to make an accurate complete census, Miss Bryant and the author walked along the high dry bank of both sides, peered into the fringe of Cat-tails and checked on a record book each abnormal specimen seen. The table that follows shows in a striking way their abundance.

Teratologic Plants of *Typha angustifolia* along ¼ mile of Alewife Brook.

Plants with 2 superposed pistillate parts of the spike	Plants with several juxtaposed pistillate parts of the spike	
1	Twinned	62
	Tripled	30
	Quadrupled	6
	Quintupled	2

Five of these plants are shown to the left in the accompanying illustration.

Plants of *T. angustifolia* with two superposed pistillate portions of the spike are also represented in the Herbarium of the New England Botanical Club and the Gray Herbarium, MASSACHUSETTS: filled land, Bay State Road, Boston, June 27, 1896, *Emile F. Williams*. KANSAS: ponds, Reno County, Aug. 25, 1897, *A. S. Hitchcock*, no. 1,125. SWITZERLAND: *N. C. Seringe*, no. 1,304. In the Herbarium of the Connecticut Agricultural Experiment Station at New Haven is a specimen from, CONNECTICUT: near New Haven, June 16, 1876, *John A. Allen*. Likewise similar cases for this species have been recorded by Dr. A. Schnizlein[9] who figures it as well, and by J.-B. Gèze.[10]

The form with two or more juxtaposed portions of the spike was so very common at this locality[11] that the not unnatural expectation was to find abundant pressed specimens and many published notes. On the contrary the Gray Herbarium and the Herbarium of the New England Botanical Club do not contain any such specimens of *T. angustifolia*, but the Academy of Natural Sciences of Philadelphia has the two following specimens: One with three juxtaposed pistillate spikes, from DELAWARE: ditches near Greenbank, June 7, 1880, *A. Commons;* and one with two juxtaposed pistillate spikes from DELAWARE: marshes, McCrones, Wilmington, Aug. 15, 1874, *A. Commons.* A prolonged search of American botanical publications did not reveal any published records of the sort. But, as before, several European botanists have detected and described the abnormality, see Beckhaus,[12] Wigand,[13] and J.-B. Gèze.[14] The latter in his monograph describes experiments and from these draws conclusions which answer the question that occurs to everyone, what is the cause of these queer forms, consequently a free translation from this portion of his treatise[15] is given here.

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[9] Die Natürliche Pflanzen-familie der Typhaceen 9 (1845).

[10] Gèze, l. c. 39.

[11] On July 16, 1940, Messrs. Fernald & Long found an extensive colony of such *Typha angustifolia* (their nos. 12,223–12,228) on Cedar Island in Back Bay, Virginia, the 2–4 spikes variously cohering, entwining or splitting apart and becoming pendulous.

In July 1909 I removed from each living spike a few flowers in order to study them under the microscope. Sometimes with a scalpel I removed a minute fragment of the female axis in order to examine the protuberances.

Ten days afterwards, the holes in the surface of the spike, caused by these operations, had disappeared, but there remained in their places depressions; fifteen days later these depressions were dotted with numerous "anlagen." In the cases where the axis had been wounded, ten days afterward a longitudinal pad appeared extending from the injured point to the base of the spike. Finally these pads with a longitudinal portion of the axis separated from the principal spike, but remained attached to the stem immediately below. The place where the pad had arisen could be recognized by a white line formed of protruding hairs on the surface of the principal spike, which had newly regained its cylindrical shape. The detached portion also, thanks to the expansion of the cluster of hairs which surround each flower, had assumed a cylindrical form.

When the piece removed had been taken from the summit of the female spike, the two resulting spikes were equal in length, but the detached part, being less rigid, warped readily into a spiral.[16] I have thus been able to obtain several secondary spikes in juxtaposition to the principal one.

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[12] Jahresb. d. Westph. Ver. f. Wiss. u. Kunst, Muenster xiv. 122 (1886).

[13] Botanische Hefte ii. 98 (1887).

[14] l. c. 40–41.

[15] l. c. 41–43.

As I have said, it was in a pasture that I collected the *Typha* with three equal juxtaposed female spikes, the axis being cleft into 3 complementary parts which on being brought together reform a full cylindrical stem. Near the place where I collected this specimen the cows were in the habit of feeding. It is natural to suppose that one of them with one munch bit off the tip of the female spike and crushed the axis into three parts quite to its base.

Dr. Kronfeld[17] attributed this longitudinal partition of the female spike to alternations of dryness and humidity. He knew a station where he observed this in *T. angustifolia* each year. Dr. Kronfeld at first believed that he had found a proof of the origin of the multiple spikes of *Typha* and drew a parallel with the case of *Andropogon*, but a profounder study of more material convinced him, as my observations did me, that this splitting of the axis is due to wounding. The sudden variations in the quantity of water contained in the spike (this quantity can attain 3 to 5 times the weight of the dry spike) tear apart the tissues of the female axis, as Dr. Kronfeld verified by an anatomical study of the axis.

From studying the fresh Cat-tails no cause for their abnormal development was determined. These same specimens were left in a warm room for a week and then examined again. This time there were some very conspicuous light colored lines on the surface of the dark spikes, caused by the fluffing out of the bristles. That appearance gave a clue immediately, and in a few seconds by prodding with the point of a pencil a caterpillar was uncovered. At the end of each of the lines of light fluff, a similar caterpillar was found. They were about a centimeter in length, yellowish white, with narrow brown lines running longitudinally on the back. These larvae were found in every one of the ab-

[16] Mr. Gèze's phrasing of this is, "mais la partie détachée, moins rigide, se tordait bientôt en spirale." He so definitely says spirale that I translate it spiral, but in the case under discussion (as shown by his Plate II. fig. B.) which is the one that I saw most frequently, the several segments are attached to the common stem at the bottom, and, during the greater part of their development, at the top also. While held in this position the spikes are not free to warp in a spiral, but on the contrary only into an arc. This is of frequent occurrence, and, I believe, is what Mr. Gèze intended to describe.

[17] Kronfeld, Dr. E.-M.: Monographie der Gattung Typha, Sitzber. Akad. Wien. i. Abt. xvi. 105, 109 (1889).

normal spikes, sometimes one, sometimes many in a spike. With this knowledge it does not seem necessary to postulate the wounding of the young spike by a cow or by any other cause than the work of these parasitic larvae. They without question cause the splitting of the spike into two or more juxtaposed parts. Fresh material of the Cat-tails containing active larvae was furnished to Dr. C. T. Brues of Harvard University and to Mr. Anthony Spuler, Assistant Entomologist of the State College of Washington. Repeated attempts were made to raise the moths, until finally in June, 1921, Mr. Spuler succeeded. The moths were then submitted to the Smithsonian Institution and Mr. August Busck identified them as *Limnoecia phragmitella* Stainton. He writes that they are "cosmopolitan—found wherever *Typha* is found."

In a popular account[18] of the habits of this moth P. W. Claasen writes that the larvae spin a web to hold the cat-tail together, that they live over winter in it, and that the night-flying moths come in July.

The locality on Alewife Brook was under observation from 1917 to 1920. A similar locality in Europe is recorded by Dr. Kronfeld, and he states that the abnormal plants are produced year after year. In the former case it is certain that the large numbers of juxtaposed spikes are produced due to the activities of this larva; in the latter case the cause is probably the same.

One point as yet does not seem to be explained. The larvae of this moth cause the spikes of *Typha angustifolia* to have an abnormal development. *T. angustifolia,* however, has a distinctly limited range, and is far less common than *T. latifolia.* The moth in question is said to be "cosmopolitan—found whereever *Typha* is found." Along Alewife Brook the moths seemed to make an unerring selection, always choosing the spikes of *T. angustifolia* instead of those of *T. latifolia* when depositing its eggs. In other localities does this moth lay its eggs in *T. latifolia*? If so, are the Cat-tails that harbor them abnormal in development?

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[18] Claasen, P. W.: The tale of the cat-tail, Nat. Study Rev. xv. 244-262 (1919).